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Abstract

LIQUID-METAL HEAT TRANSFER

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This paper will summarize, and indicate the significance of, recent advances in the study of liquid-metal heat transfer, with particular emphasis on applications to the design of liquid-metal-cooled nuclear power plants. The paper will treat only that pertinent information generated in the United States in the years 1958 through 1963. In the second half of this six-year period, more liquid-metal heat transfer information was published than in any previous three-year period. The tendency in the United States has been to carry out both fundamental analytical and experimental studies on simple, well-defined, and controlled systems rather than to measure heat transfer rates on prototype heat-exchange equipment.

For single-phase liquid-metal heat transfer, new theoretical and semi-empirical expressions have become available for predicting heat-transfer coefficients, under various flow conditions, for both flow through channels and flow past submerged bodies. In the former category, the cases treated have been annuli, parallel plates, and in-line flow through rod (or tube) bundles; in the latter, spheres, and flow normal to cylinders of circular and elliptical cross sections. These last cases can be considered as good approximations of those involving flow at various angles across rods in a rod bundle (or tubes in a tube bank).

In channel flow, theoretical equations for Nusselt numbers contain the term ψ, the ratio of the eddy diffusivity of heat transfer to that of momentum transfer, while semi-empirical equations contain $\bar{\psi}$, an effective average value of ψ. A major problem in predicting heat-transfer coefficients is the evaluation of these ratios. We now have a better understanding of the general shape of the typical Nusselt number vs. Peclet number curve for